CLAIMS:

1. A measurement system for use for non-invasive measurements in a human body, the system comprising:

- a measurement unit comprising an optical unit having an illumination assembly and a light detection assembly; and an acoustic unit for generating acoustic radiation; the measurement unit being configured and operable to provide an operating condition such that the acoustic radiation overlap with a certain illuminated region in the body, and that the detection assembly collects light scattered from said certain region, measured data generated by the detection assembly being thereby indicative of scattered light having photons tagged and untagged by the acoustic radiation, thereby enabling to identify a light response of said certain region to illuminating light;

- a control unit connectable to the optical unit and to the acoustic unit, the control unit being preprogrammed to operate the acoustic unit with at least two different operating conditions to vary at least one characteristic of acoustic radiation, the control unit being responsive to the measured data and preprogrammed to process and analyze the measured data to extract therefrom a data portion associated with the light response of said certain region, thereby enabling determination of a property of a tissue component in said certain region based on a relation between the measured data corresponding to the at least two different operating conditions of the acoustic unit.

2. The system of Claim 1, wherein the control unit is configured and operable to operate the acoustic unit with said at least two different operating conditions that induce two different effective pathlengths of tagged photons.

3. The system of Claim 2, wherein the control unit is configured and operable to analyze the measured data to determine data indicative of a difference in an optical attenuation parameter measured with said at least two different effective optical pathlengths.

4. The system of Claim 2, wherein the control unit is configured and operable to operate the acoustic unit to irradiate with the acoustic radiation at least two different volumes within the illuminated region.

5. The system of Claim 4, wherein the control unit is configured to operate the acoustic unit to generate the acoustic radiation in the form of acoustic pulses with the at least two different values T_1 and T_2 of duration of acoustic pulses.

6. The system of Claim 5, wherein the control unit is configured and operable to operate the acoustic unit to produce the acoustic radiation in the form of the acoustic pulses of the different durations but substantially equal amplitude, frequency and phase.

7. The system of Claim 5, wherein the control unit is configured and operable to operate the acoustic unit to produce a first sequence of pulses each of the first duration T_1, followed by a second sequence of pulses each of the second duration T_2.

8. The system of Claim 5, wherein the control unit is configured and operable to operate the acoustic unit to produce a sequence of pulses of the alternating first and second durations T_1 and T_2.

9. The system of Claim 4, wherein the control unit is configured to operate the acoustic unit to generate the acoustic radiation of the at least two different values of a beam waist.

10. The system of Claim 5, wherein the control unit is configured to operate the acoustic unit to generate the acoustic radiation of the at least two different values of a beam waist.

11. The system of Claim 2, wherein the control unit is configured and operable to operate the acoustic unit to produce the acoustic radiation causing at least two different tagging efficiencies of photons scattered from the said certain region.

12. The system of Claim 4, wherein the control unit is configured and operable to operate the acoustic unit to produce the acoustic radiation causing at

least two different tagging efficiencies of photons scattered from the said certain region.

13. The system of Clam 11, wherein the control unit is configured and operable to operate the acoustic unit to generate the acoustic radiation in the form of pulses having the at least two different values A_1 and A_2 of amplitude.

14. The system of Clam 12, wherein the control unit is configured and operable to operate the acoustic unit to generate the acoustic radiation in the form of pulses having the at least two different values A_1 and A_2 of amplitude.

15. The system of Claim 13, wherein the control unit is configured and operable to operate the acoustic unit to produce the acoustic pulses of the different amplitudes, but substantially equal frequency, phase, and duration.

16. The system of Claim 13, wherein the control unit is configured and operable to operate the acoustic unit to produce a first sequence of pulses each of the first amplitude A_1, followed by a second sequence of pulses each of the second amplitude A_2.

17. The system of Claim 13, wherein the control unit is configured and operable to operate the acoustic unit to produce a sequence of pulses of the alternating first and second amplitudes A_1 and A_2.

18. The system of Claim 11, wherein the control unit is configured and operable to operate the acoustic unit to generate the acoustic radiation in the form of continuously chirped signals having the at least two different values GC_1 and GC_2 of a gradient of the chirping.

19. The system of Claim 12, wherein the control unit is configured and operable to operate the acoustic unit to generate the acoustic radiation in the form of continuously chirped signals having the at least two different values GC_1 and GC_2 of a gradient of the chirping.

20. The system of Claim 13, wherein the control unit is configured and operable to operate the acoustic unit to generate the acoustic radiation in the form of continuously chirped signals having the at least two different values GC_1 and GC_2 of a gradient of the chirping.

21. The system of Clam 11, wherein the control unit is configured to operate the acoustic unit to generate the acoustic radiation in the form of pulses having the at least two different values F_1 and F_2 of frequency of acoustic pulses.

22. The system of Claim 21, wherein the control unit is configured and operable to operate the acoustic unit to produce the acoustic pulses of the different frequencies, but substantially equal amplitude, phase, and duration.

23. The system of Claim 21, wherein the control unit is configured and operable to operate the acoustic unit to produce a first sequence of pulses each of the first frequency F_1, followed by a second sequence of pulses of the second frequency F_2.

24. The system of Claim 21, wherein the control unit is configured and operable to operate the acoustic unit to produce a sequence of pulses of the alternating first and second frequencies F_1 and F_2.

25. The system of Clam 12, wherein the control unit is configured and operable to operate the acoustic unit to generate the acoustic radiation in the form of pulses having the at least two different values F_1 and F_2 of frequency of acoustic pulses.

26. The system of Clam 13, wherein the control unit is configured and operable to operate the acoustic unit to generate the acoustic radiation in the form of pulses having the at least two different values F_1 and F_2 of frequency of acoustic pulses.

27. The system of Claim 1, comprising a support structure configured to be placed on a body part under measurement, and carrying at least light input and output ports associated with the illumination and detection assemblies; and at least one acoustic port.

28. The system of Claim 27, wherein the supports structure is configured as a flexible band.

29. The system of claim 27, wherein the at least one light output port of the illumination assembly is connected by an optical guiding unit to at least one light emitter located outside the support structure.

30. The system of Claim 27, wherein the support structure carries the illumination assembly connectable to the control unit.

31. The system of Claim 27, wherein the at least one light input port of the detection assembly is connected by an optical guiding unit to at least one light detector located outside the support structure.

32. The system of Claim 27, wherein the support structure carries the light detection assembly connectable to the control unit.

33. The system of Claim 27, wherein the at least one acoustic port of the acoustic unit is connectable by an acoustic waves guiding unit to an acoustic transducer arrangement located outside the support structure.

34. The system of Claim 27, wherein the support structure carries the acoustic unit connectable to the control unit.

35. The system of Claim 27, wherein the support structure comprises at least two light output ports associated with the illumination assembly, and at least two light input ports associated with the light detection assembly, the control unit being configured and operable to select at least one light output port and at least one light input port to be activated during the system operation.

36. The system of Claim 1, wherein the control unit is configured and operable to identify said certain region that is to be targeted by the illumination and acoustic radiation.

37. The system of Claim 36, wherein the control unit is configured and operable to actuate the optical and acoustic units to irradiate with the acoustic radiation a plurality of regions in the illuminated part of the body and detect scattered photons; and to analyze the measured data to identify tagged and untagged light signals associated with each of said regions to determine a parameter indicative of optical attenuation of each of said regions, thereby enabling identification of said certain region for actual measurements by comparing the determined parameters to reference data.

38. The system of Claim 1, wherein:

- the illumination assembly comprises at least one light emitter, and first and second illuminating light guiding units optically coupled to each other by a first optical coupler, so as to couple light from said at least one light emitter into the first illuminating light guiding unit to be further coupled by the first optical coupler to the second illuminating light guiding unit, a distal end of the second illuminating light guiding unit presenting a light output port of the illumination assembly, said first optical coupler being optically coupled to a connecting light guiding unit and being configured to couple a predetermined portion of the input light coming from the first illuminating light guiding unit into the second illuminating light guiding unit and couple another portion of the input light to said connecting light guiding unit;
- the detection assembly comprises at least one light detector; and first and second collected light guiding units optically coupled to each other by a second optical coupler, a distal end of the first collected light guiding unit presenting a light input port of the detection assembly, the second optical coupler being optically coupled to said first collected light guiding unit and being configured to couple a predetermined portion of the collected light coming from the first collected light guiding unit into the second collected light guiding unit, and couple a portion of output light from the connecting light guiding unit into the second collected light guiding unit;

lengths of the light guiding units and position of the first and second couplers being selected so as to satisfy a coherence length requirement to enable interference between photons from the connecting light guiding unit with the collected tagged and untagged photons at the second coupler.

39. The system of Claim 38, comprising a light modulator located in an optical path of light passing through said connecting light guiding unit.

40. The system of Claim 1, wherein the acoustic unit comprises at least one acoustic transducer arrangement.

41. The system of Claim 40, wherein the acoustic transducer arrangement comprises a phase array of acoustic transducers.

42. The system of Claim 41, wherein each of the transducers has a substantially annular shape, the transducers being arranged in a concentric manner to be placed on a body part under measurement; an array of light input and output ports associated with respectively the detection and illumination assemblies being located within an inner region defined by the transducers.

43. The system of Claim 42, wherein number and dimensions of the acoustic transducers are selected to correspond to a predetermined focal depth for the acoustic transducer arrangement.

44. The system of Claim 41, wherein said phase array is formed by a two substantially symmetrically identical groups of transducers arranged in a spaced-apart relation, each group being formed by concentrically arranged transducers having a common center, an array of light input and output ports associated with respectively the detection and illumination assemblies being located within a space between the two groups of transducers.

45. The system of claim 1, configured for measuring in a Jugular vein bulb, the measurement unit being configured for allowing insertion of at least a part of the acoustic unit associated with an acoustic output port into an external ear canal, such that an output face of the acoustic unit forms an acoustic contact with outer walls of the external ear canal, thereby enabling directing the acoustic radiation through the ear canal and focusing it on the Jugular vein bulb.

46. The system of Claim 45, wherein the acoustic unit comprises an array of acoustic transducer elements configured and operable to emit the acoustic radiation with at least one controllable parameter selected from a direction, a phase and a time delay of the acoustic radiation emission.

47. The system of Claim 1, wherein the detection assembly is configured and operable to generate the measured data indicative of the collected tagged photons based on principles of interference with a local oscillator; and the

control unit is preprogrammed for analyzing the measured data corresponding to each wavelength of the incident light.

48. The system of Claim 1, wherein the control unit is configured and operable to process the measured data to identify a data portion corresponding to the collected tagged photons, using frequency analysis and/or speckle imaging.

49. A method for use for non-invasive measurements in a human body, the method comprising: applying acoustic radiation to a certain illuminated region in the body, with at least two different conditions of the applied radiation achievable by varying at least one characteristic of the acoustic radiation; detecting light scattered from the body part and generating measured data indicative of detected photons tagged and untagged by the acoustic radiation; analyzing the measured data to extract therefrom a data portion corresponding to the tagged photons and being therefore associated with a light response of said certain region, to thereby enable determination of tissue properties of said certain region based on a relation between the measured data portions corresponding to the at least two different operating conditions.

50. The method of Claim 49, wherein said at least two different operating conditions of the acoustic irradiation induce two different effective optical pathlengths of the tagged photons scattered at said certain region.

51. The method of Claim 50, wherein said at least two different effective optical pathlengths are achieved by irradiating by the acoustic radiation at least two different volumes of said certain region.

52. The method of Claim 51, wherein said at least one varying characteristic between said at least two different operating conditions of the acoustic radiation includes a duration of pulses of the acoustic radiation.

53. The method of Claim 50 wherein said at least one varying characteristic between said at least two different operating conditions of the acoustic radiation includes an acoustic beam waist.

54. The method of Claim 51, wherein said at least one varying characteristic between said at least two different operating conditions of the acoustic radiation includes an acoustic beam waist.

55. The method of Claim 50, wherein said at least two different effective pathlengths are achieved by irradiating with the acoustic radiation so as to provide at least two different values of tagging efficiency in the detected light.

56. The method of Claim 51, wherein said at least two different effective pathlengths are achieved by irradiating with the acoustic radiation so as to provide at least two different values of tagging efficiency in the detected light.

57. The method of Claim 56, wherein said at least one varying characteristic between said at least two different operating conditions of the acoustic radiation includes an amplitude of the acoustic radiation pulses.

58. The method of Claim 56, wherein said at least one varying characteristic between said at least two different operating conditions of the acoustic radiation includes a frequency of the acoustic radiation pulses.

59. The method of Claim 57, wherein said at least one varying characteristic between said at least two different operating conditions of the acoustic radiation includes a frequency of the acoustic radiation pulses.

60. The method of Claim 56, wherein said at least one varying characteristic between said at least two different operating conditions of the acoustic radiation includes a gradient of chirping of the acoustic radiation.

61. The method of Claim 57, wherein said at least one varying characteristic between said at least two different operating conditions of the acoustic radiation includes a gradient of chirping of the acoustic radiation.

62. The method of Claim 58, wherein said at least one varying characteristic between said at least two different operating conditions of the acoustic radiation includes a gradient of chirping of the acoustic radiation.

63. The method of Claim 49 for use for measuring in a Jugular vein bulb, the method comprising: inserting at least a part of an acoustic unit associated with an acoustic output port into an external ear canal, such that an

output face of the acoustic unit forms an acoustic contact with outer walls of the external ear canal; and operating the acoustic unit to direct the acoustic radiation through the ear canal and focus it on the Jugular vein bulb.

64. The method of Claim 63, wherein said operating comprises selecting a desired value of at least one of a direction, a phase and a time delay parameter for each of acoustic transducer elements from an array of such elements.

65. The method of Claim 63, comprising providing reference data indicative of images of the Jugular vein bulb, and using this data for precisely locating the acoustic output port relative to the ear canal.

66. The method of Claim 49, wherein said detecting of the scattered light and generating of the measured data comprises utilizing principles of interference with a local oscillator to generate the measured data portion indicative of the collected tagged photons; the measured data being analyzed for each wavelength of the incident light.

67. The method of Claim 49, wherein said processing of the measured data comprises identifying a data portion corresponding to the detected tagged photons using frequency analysis and/or speckle imaging.

68. The method of Claim 49, comprising separating a portion of illuminating light while propagating inside an illuminating light guiding arrangement towards the body part, and coupling a predetermined portion of said separated portion of the illuminating light to a collected light guiding arrangement so as to cause said predetermined coupled light portion to interfere with light collected from the body part, thereby enabling the processing of the measured data to extract therefrom data indicative of effects related to the overall light propagation in the body tissues from an illumination assembly to a detection assembly and local effects of a tagged volume in the body.

69. The method of Claim 49, comprising separating a portion of illuminating light while propagating inside an illuminating light guiding arrangement towards the body part, passing the separated light portion though a

light modulator, and coupling a predetermined portion of the modulated light to a collected light guiding arrangement to cause said predetermined coupled light portion to interfere with light collected from body part, thereby enabling the processing of the measured data to extract therefrom data indicative of effects related to the overall light propagation in the body tissues from an illumination assembly to a detection assembly and local effects of a tagged volume in the body.

70. A probe device for use in a system for monitoring tissue properties in a human body, the probe comprising: a support structure configured to contact a body portion, said support structure carrying an array of at least two light output ports arranged in a spaced-apart relationship and being connectable to a light source assembly, an array of light input ports arranged in a spaced-apart relationship and being connectable to a light detection assembly, and at least one acoustic output port of an acoustic unit, the arrangement of the light ports and the acoustic port being such as to allow selection of at least one of said light output ports, at least one of the light input ports and at least one of the acoustic output ports such that acoustic radiation of a predetermined frequency range coming from said at least one selected acoustic output port and illuminating light coming from said at least one selected light output port overlap within a region of interest in the body, and in that said at least one light input port collects light scattered from the overlapping region and light scattered from outside the region of interest.